Table of Contents
(Continued)

Section **Page**

Table of Contents
(Continued)

Section **Page**

Chapter Seventeen

QUANTITY ESTIMATING

In addition to preparing clear and concise plans, as described in Chapter Fourteen, the designer needs to compile an accurate summary of the project quantities. This information leads directly to the project cost estimate, which combines the computed quantities of work and the estimated unit bid prices. An accurate summary of quantities is critical to prospective contractors interested in submitting a bid on the project. In addition to the INDOT *Standard Drawings* and the INDOT *Standard Specifications*, Chapter Seventeen presents additional guidelines on calculating quantities for highway, bridge and traffic projects.

17-1.0 GENERAL

17-1.01 Guidelines for Preparing Quantity Computations

When preparing quantity computations, the designer should consider the following guidelines.

1. Specifications. Cross check all items against the INDOT *Standard Specifications* and the Supplemental Specifications to ensure that the appropriate pay items, methods of measurement and basis of payment are used. If an item is not covered in the *Standard Specifications* or Supplemental Specifications, a unique special provision must be included in the contract documents to cover the item. Chapter Nineteen discusses how to prepare special provisions.

2. Pay Item Code Number. Every pay item has a unique number assigned to it for data processing. This code number is located in the computer programs CES and Estimator. Section 20-2.01 describes these programs. Only the official name and description should be used in the contract documents, special provisions and summary of quantities.

3. Rounding. The quantity of any item provided in the plans should check exactly with the figure on the computation sheets. Indicate any rounding of the raw estimated figures on the computation sheets. Unless stated otherwise, no rounding of the calculations should be done until the value is incorporated into the Quantity Summary Tables.

4. Significant Digits. When calculating quantities, carefully consider the implied correspondence between the accuracy of the data and the given number of digits.

5. Cost Estimate. Only use the total values from the Quantity Summary Tables to develop the cost estimate. Show all items described in the plans that will be included in the cost estimate on the plan sheets. The designer will be responsible for inserting these values into either CES or Estimator.

17-1.02 Computation Records

Quantity computation sheets may be generated by computer or by hand. Combine all computation sheets and bind them with a cover sheet. The preparer will sign or initial and date each sheet. The checker will also be required to sign or initial and date each sheet.

Check all values obtained through computations or use of standardized tables. For those pay items where agreements may be reached to make payment on the basis of plan quantities, an independent check should be performed and noted. Note the resolution of any differences between original and check computations. Where computations are performed by computer, an independent check is generally not required. However, check the input and review the computation output sheet for mistakes. Also, sign and date the computer output similarly to hand computation sheets.

Retain the quantity computations within the project file.

The contractor may request copies of the quantity calculations subsequent to the letting. Requests prior to the letting from contractors should be directed through the Legal Division.

17-1.03 Units of Measurement

Quantities for all contract pay items should be estimated using the measurement units shown in the INDOT *Standard Specifications* or the special provisions. The values determined from the computations should be rounded as described below and shown in the quantities-summary tables and elsewhere in the plans as required.

In general, rounding of values should be as follows.

1. Small Quantity. For a quantity of 10 or less, round to the nearer whole unit (i.e., 3.2 to 3, 5.5 to 6, or 9.8 to 10).

2. Large Quantity. For a quantity greater than 10, round up to the next whole unit (i.e., 27.8 to 28, or 146.2 to 147).

3. Linearly-Measured Work. Round each linear-measure quantity up to the next higher 0.5 m.

4. Earthwork. For an individual cross-section area, round to the nearer 0.1 m^2. For an individual end-area volume, round to the nearer 1 m^3. For a total pay quantity, round up to the next multiple of 5 m^3.

5. Structural Concrete. Round each structural-concrete quantity to the nearest 0.1 m^3. This includes each individual pour or structure portion and the total quantity for each concrete class shown in bills of materials and the Bridge Summary Sheet.

The values shown in the Estimate of Quantities and Cost Estimate developed by the designer should reflect this rounding procedure. The Engineer's Estimate and Schedule of Pay Items developed by the Contracts Administration Division's Estimating Office will also reflect this procedure.

17-1.04 Non-Defined Work

17-1.04(01) Lump-Sum Items

Only use lump sum bid items where the scope of work for the item is clearly defined, and the amount of work has a minimal chance of changing during construction. The INDOT *Standard Specifications* defines which quantities may be estimated as lump sum. Wherever practical, list the quantities for the separate items that will be included within the lump-sum item. The list should note that the separate "quantities are for estimating purposes only." Where there is a significant chance of quantity changes, the work must be bid by the unit and not lump sum.

17-1.04(02) Items Included in Other Work

In general, no item should be shown as incidental to another pay item or the contract. If any item will be included as part of another item, it must be addressed by the specifications or with a special provision. The designer should only include an item of work in another pay item where the scope of work for both is clearly defined and the probability of the quantity of either item changing is minimal. In general, minimize the use of items included in other pay items. It is impossible for bidders, or the Department, to prepare an estimate for a project which contains incidental items for which quantities or the scope of work are indeterminable.

17-1.05 Proprietary Materials

To ensure competitive bidding, the designer should restrict the use of proprietary materials on a project. Proprietary materials are defined as specifications that are so specific that only one product will satisfy the requirements, or the name of the product is actually specified. However, when a situation occurs on a project where the use of a proprietary material will enhance safety, control costs or otherwise improve the project design, the use of a proprietary material may be justifiable. Where this is applicable, the designer should consider the following.

1. Justification. The designer must prepare a justification for the use of the proprietary material. The justification should include a description of the circumstance being addressed by the proprietary material, alternative solutions considered and the reasoning why the proprietary material was chosen. Figure 17-1A, Justification for Use of Proprietary Material, illustrates the form that should be used to request approval for the proprietary material. An editable version of this form may also be found on the Department's website at www.in.gov/dot/div/contracts/design/dmforms/

2. Existing Facilities. Proprietary materials may be justified where they are essential for synchronization with existing highway facilities, for which there is no equally suitable alternative.

3. Experimental. Proprietary materials may be justified for research purposes or for a distinctive type of roadway. Justifications for experimental or research items must include a work plan detailing the evaluation to be conducted. Projects on the State highway system must follow the procedures in the *INDOT Guidelines for Initiating and Reporting Experimental Features Studies*.

4. Approval. Submit the justification to the Design Division, Chief for approval. This may occur anytime between design approval and submittal of the final plans. Proprietary materials on non-exempt NHS projects will require FHWA approval. This will occur when the PS&E is submitted for the letting.

5. Approved Proprietary Materials. Lists of approved proprietary materials which have been found to be in the public interest for use may be found on the Department's website, at www.in.gov\dot\business\a_mat\index.html . Figure 17-1B lists approved proprietary materials which do not appear on the website's lists. No justification is required if such materials are specified for use on a project.

17-3.0 ROADWAY QUANTITIES

17-3.01 Pavement Materials

Chapter Fifty-two discusses INDOT pavement design criteria. It also provides information for quantity determinations for subgrades, asphalt materials, concrete materials, underdrains and geotextile wraps. Figure 17-3A, Roadway Factors, provides factors that can be used to determine asphalt pavement and other roadway quantities.

The following method should be used to determine quantities for shoulder corrugations. For an Interstate route, it is sufficient to multiply the number of shoulders requiring corrugations, usually four, by the gross project length in meters. For another type of facility, it is acceptable to multiply the number of shoulders that require corrugations by the gross project length in meters by 0.8 to account for the gaps in the intermittent corrugation pattern. It is not necessary to subtract the length of gaps at bridge approach slabs and bridge decks, driveways, median crossovers, and public road approaches when calculating the quantity. It is also not necessary to subtract the length of non-corrugated shoulder less than 2.1 m wide adjacent to a roadside barrier.

17-3.02 Subgrade Treatment

The subgrade is defined as the top surface of a roadbed upon which the pavement structure and shoulders are constructed. The subgrade area should be computed for all areas of new pavement or shoulders, including cuts and fills. The width of the treatment is between points which are 0.6 m, or as determined, outside the edges of paved shoulders or back faces of curbs, as shown in Chapter Fifty-two, or as instructed by the Production Management Division's Geotechnical Services Office. The lateral limits and type of subgrade treatment should be shown on the Typical Cross Sections on the plans.

17-3.02(01) Subgrade Treatment Types

For each of the subgrade treatment types described below, the contractor is to choose from the applicable options for each type. Where subgrade treatment other than that described here is recommended by the Geotechnical Services Office, a special provision should be prepared.

The subgrade treatment methods are as follows:

1. Type I. The contractor's options are as follows:
   a. 400 mm chemical soil modification;
   b. 300 mm of the subgrade excavated and replaced with coarse aggregate No. 53; or
   c. 600 mm of soil compacted to density and moisture requirements.
2. Type IA. The contractor's options are as follows:
   a. 400 mm chemical soil modification; or
   b. 300 mm of the subgrade excavated and replaced with coarse aggregate No. 53.

Asphalt Mixtures	
Pavement Thickness	Factor
25 mm	60 kg/m^2 = 0.060 Mg/m^2
31 mm	75 kg/m^2 = 0.075 Mg/m^2
38 mm	90 kg/m^2 = 0.090 Mg/m^2
42 mm	100 kg/m^2 = 0.100 Mg/m^2
50 mm	120 kg/m^2 = 0.120 Mg/m^2
58 mm	140 kg/m^2 = 0.140 Mg/m^2
63 mm	150 kg/m^2 = 0.150 Mg/m^2
69 mm	165 kg/m^2 = 0.165 Mg/m^2
75 mm	180 kg/m^2 = 0.180 Mg/m^2
83 mm	200 kg/m^2 = 0.200 Mg/m^2
91 mm	210 kg/m^2 = 0.210 Mg/m^2
113 mm	270 kg/m^2 = 0.270 Mg/m^2
200 mm	480 kg/m^2 = 0.480 Mg/m^2
Asphalt for Prime Coat	2.8 L/m^2 = 0.0028 Mg/m^2
Asphalt for Tack Coat	0.25 L/m^2 = 0.00025 Mg/m^2
Riprap	
Riprap	1.8 Mg/m^3
Water for Sodding	
Water	18 L/m^2 = 0.018 kL/m^2
Pavement Markings	
Permanent Broken Centerline	0.250 m/m

Compacted Aggregate	
Aggregate Thickness	Factor
75 mm	0.178 Mg/m^2
100 mm	0.237 Mg/m^2
125 mm	0.297 Mg/m^2
150 mm	0.356 Mg/m^2
175 mm	0.415 Mg/m^2
200 mm	0.475 Mg/m^2
225 mm	0.534 Mg/m^2
300 mm	0.712 Mg/m^2
B Borrow for Draintile	
Pipe Dia.	Factor
150 mm	0.643 m^3/m
200 mm	0.672 m^3/m
250 mm	0.694 m^3/m
300 mm	0.760 m^3/m
450 mm	1.254 m^3/m
Aggregate for Underdrains	
Pipe Dia.	Factor
150 mm	0.226 m^3/m
200 mm	0.276 m^3/m
250 mm	0.339 m^3/m
Shoulder Drains	
Flat Terrain	14.0 Mg/km
Rolling Terrain	17.0 Mg/km
Hilly Terrain	20.0 Mg/km

ROADWAY QUANTITIES FACTORS

Figure 17-3A

U.S. Geological Survey
Mid-Continent Mapping Center, MS 309
1400 Independence Road
Rolla, MO 65401
Telephone: (573) 308-3808
Fax: (573) 308-3652

17-3.10 Seeding and Sodding

17-3.10(01) Seeding for Grading and Paving Project

The following will apply.

1. Rural Area 4000 m^2 or Larger. Such an area within the right-of-way that is not sodded or paved should be seeded as follows.

    a. Seeding. Use the seed mixture R as specified in the INDOT *Standard Specifications*. Estimate the quantity assuming an application rate of 190 kg/ha.

    b. Mulching. Use the pay item Mulching Material and estimate it at a rate of 4.5 Mg/ha.

    c. Fertilizer. For estimating purposes, assume an application rate of 900 kg/ha.

2. Urban Area 4000 m^2 or Larger. Such an area within the right-of-way that is not sodded or paved should be seeded as follows.

    a. Seeding. Use the seed mixture U as specified in the INDOT *Standard Specifications*. Estimate the quantity assuming an application rate of 165 kg/ha.

    b. Mulching. Use the pay item Mulching Material and estimate it at a rate of 4.5 Mg/ha.

    c. Fertilizer. For estimating purposes, assume an application rate of 900 kg/ha.

3. Rural Area less than 4000 m^2. For such an area within the right-of-way which is not sodded or paved, use the pay item Mulched Seeding, Class R. Estimate the area and pay quantity in square meters.

4. Urban Area less than 4000 m^2. For such an area within the right-of-way which is not sodded or paved, use the pay item Mulched Seeding, Class U. Estimate the area and pay quantity in square meters.

17-3.10(02) Seeding for Grading Project

The following will apply.

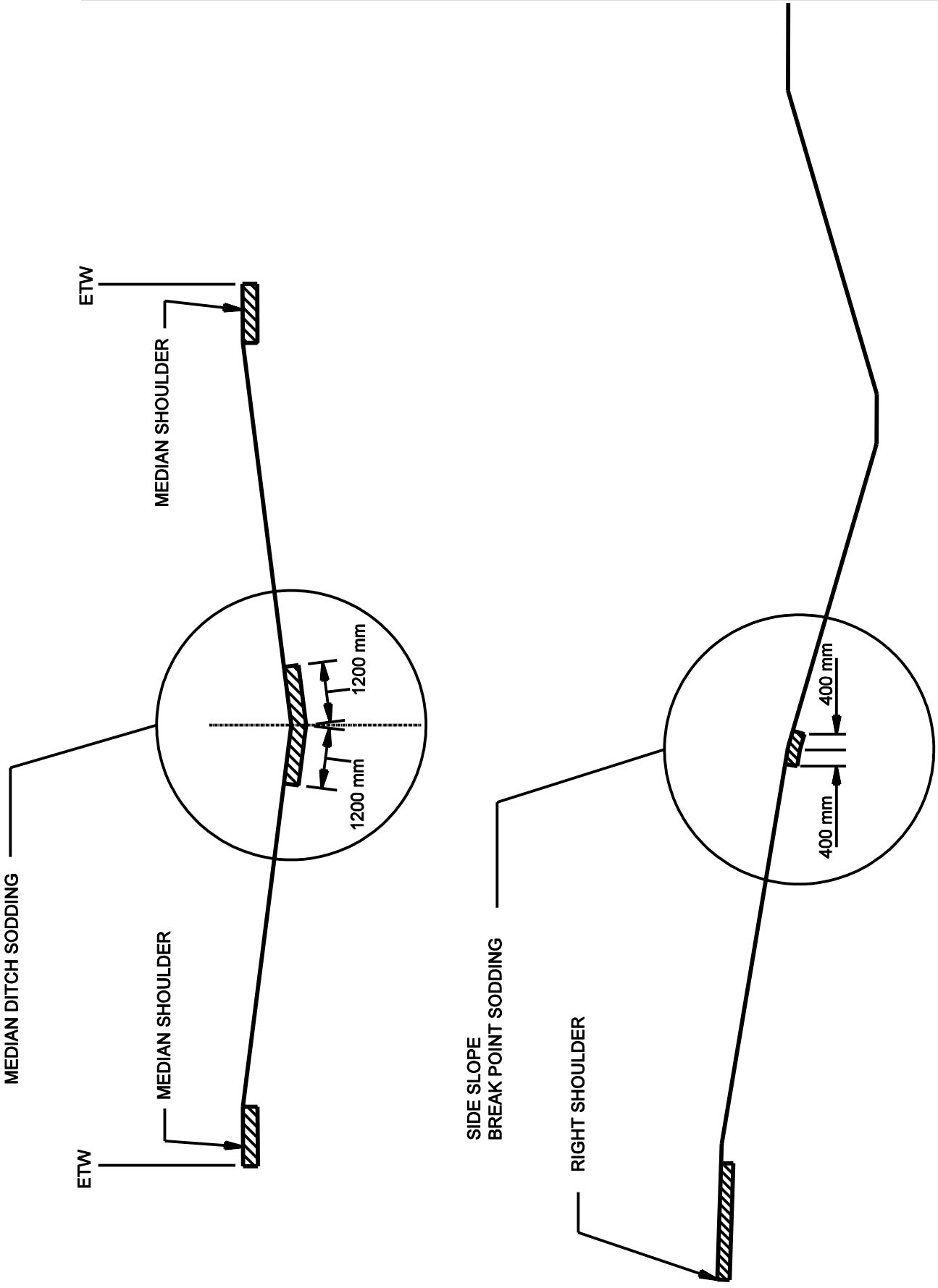
1. Shoulder Point to Shoulder Point. The area within the outside shoulder points should be seeded as follows.

   a. Seeding. Use the seed mixture P as specified in the INDOT *Standard Specifications*. Estimate the quantity assuming an application rate of 90 kg/ha.

   b. Fertilizer. For estimating purposes, assume an application rate of 450 kg/ha.

2. Shoulder Point to Right-of-Way. The area within the outside shoulder points and the edge of right-of-way should be seeded as described in Section 17-3.10(01).

17-3.10(03) [Section Deleted]



SODDING LOCATIONS

Figure 17-3I

3. Estimates. Estimate the area of sod and nursery sod in square meters.

4. Water. To estimate the amount of additional water required for sod and nursery sod, assume a rate of 18 L/m^2. The pay unit is kiloliter, symbol kL.

17-3.10(08) Mobilization and Demobilization for Seeding

All projects which include seeding pay items should include at least one each of the pay item Mobilization and Demobilization for Seeding. If the project includes a temporary runaround, add at least one additional unit to the estimate. Additional units may be added as required for the likely progression of work (e.g., for the various construction phases).

17-3.11 No-Passing-Zone Pavement Markings

If no-passing zones extend beyond the project limits, striping quantities should include required solid yellow lines and adjacent broken yellow lines to the ends of such no-passing zones.

17-3.12 Spare Parts Packages for Guardrail End Treatments or Impact Attenuators

If guardrail end treatments or impact attenuators are required, the designer should contact the appropriate district operations engineer regarding the number of each type and stage of spare parts packages desired. The district operations engineer will provide the number of each required, along with the delivery location. Only one delivery address will be permitted for each contract. The appropriate recurring special provisions should be modified to incorporate this information and included in the contract documents. The appropriate pay items and quantities should be incorporated into the estimate of quantities and cost estimate.

17-3.13 Temporary Traffic Barrier (TTB)

The total pay quantity of each type of TTB should be computed only once, regardless of how may traffic-maintenance phases it is to be used in, or how many times it must be moved.

The length of the longitudinal portion of TTB should be taken from the beginning point of where it is required to the ending point of where it is required. Gaps required to accommodate public road approaches or drives should be subtracted out. The length of each such gap should be taken as the approach or drive width plus its radii. The lengths of flared portions should be measured along the flares.

Construction zone energy absorbing terminals, if required for use with TTB type 1 or type 3, are separate pay items to be quantified only once, regardless of how may traffic-maintenance phases they are to be used in, or how many times they must be moved. The length of each construction zone energy absorbing terminal, if required for use with TTB type 2 or 4, should be taken as 11.43 m where used along an outside shoulder, or3.81 m where used along a median shoulder. Such lengths should be included in the linear quantities of TTB.

Delineation, and anchoring or other means required to control deflection, are included in the cost of TTB, so they should not be considered when determining the pay quantities.